

C-4

C-4-1 W M M M M M M M



Memorandum

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January 10, 2017

TO: Andrew Boushy, Aquila Resources Inc.

CC: Steve Donohue, Foth Infrastructure & Environment, LLC
Master File

FR: Kris Baran, Foth Infrastructure & Environment, LLC
John Starke, Foth Infrastructure & Environment, LLC
Raymond Wong, Foth Canada Corporation

RE: Back Forty Project Design of Cut-off Wall/River Road Realignment/East Access Power Corridor - Revised

Introduction

Aquila Resources Inc. (Aquila) is preparing a Mining Permit Application (MPA) for the Back Forty Project, which is located in western Menominee County, about 15 miles northwest of Stephenson, Michigan. The project consists of mining a volcanogenic massive sulfide deposit of zinc and copper as an open pit. The planned open pit is bounded to the west by the Menominee River. A cut-off wall is proposed to restrict seepage from the Menominee River to the open pit and improve the stability of the pit slope. Figure 1 shows the general location of the open pit, proposed cut-off wall alignment, and proposed River Road realignment.

This memorandum presents the Permit Level design for the Menominee River cut-off wall based on the finalized open pit configuration by Aquila. The work is based on preliminary geotechnical investigation and cut-off wall alternative evaluation completed by Golder Associates Inc. in 2011 (Golder, 2011). From the preliminary concept description prepared by Golder, as well as the updated pit shell included with the Preliminary Economic Analysis (PEA) (Tetra Tech, 2014), Foth has prepared the cut-off wall design to support the MPA including:

- ♦ Layout the cut-off wall alignment based on the finalized open pit configuration (Pit 32).
- ♦ Finalize the construction method and cut-off wall mix design.

- ♦ Update seepage estimates based on the realigned length and depth of the cut-off wall.
- ♦ Design of the cut-off wall containment structure.
- ♦ Determine optimum overburden slope configuration.

Previous Geotechnical Investigation and Study

In 2011 Golder was retained by Aquila to provide technical support on a cut-off wall design to minimize seepage from the adjacent Menominee River into the planned open pit. A geotechnical investigation for the cut-off wall design was carried out in 2011. The scope of work covered by Golder's evaluation includes the following:

- ♦ Evaluating preliminary seepage analyses and determining the need for a cut-off wall structure.
- ♦ Comparing concept alternative cut-off wall construction methods with respect to constructability, performance (efficiency), environmental impact/footprint, order of magnitude construction cost, and potential requirement for bedrock grouting based upon previous mine description.
- ♦ Recommend technically feasibility cut-off descriptions for the project.

Cut-off Wall Design

Design Basis

The cut-off wall is designed and constructed as a low permeability barrier through the overburden soils to impede seepage from the Menominee River into the proposed open pit and at the same time to reduce the hydraulic gradient in the overburden soil to improve slope stability. The selection of the type of cut-off wall construction technique shall be based on the ability of such method to excavate the on-site soils and rock in an efficient manner and provide the best performance as a low permeability barrier.

The pertinent design criteria of the Back Forty project cut-off wall are presented in Table 1.

Table 1
Cut-off Wall Design Criteria

Description	Design Value
Minimum hydraulic conductivity	1×10^{-8} m/s
Minimum unconfined compression strength	500 kPa (5 tons/feet ²)
Minimum embedment depth in weathered rock	2 m (6 feet)
Design maximum flood level of the Menominee River for a 100-year, 24-hour storm (Foth, 2015)	212 m

Description	Design Value
Minimum set-back distance	30.5 m (100 feet) to the maximum flood level, i.e., 212 m
m/s = meter per second	Prepared by: RXW
feet ² = square feet	Checked by: MJV2
m = meter	

Cut-off Wall Types

Four (4) cut-off wall construction alternatives were considered for the Back Forty Project including:

- ♦ Conventional Excavation (long-reach excavator).
- ♦ Clamshell Excavation.
- ♦ Cutter Soil Mixing (CSM).
- ♦ Trench Cutter (TC).

Of these, it is concluded that the CSM and the TC methods are best suited for constructing the cut-off wall in the soil and bedrock conditions present at the Project site. The Conventional Excavation and Clamshell Excavation methods were rejected due to limitations as outlined below:

- ♦ Difficult to control verticality.
- ♦ Not suitable for dense/stiff soils, cobbles and boulders.
- ♦ Cannot excavate bedrock.
- ♦ Cleaning if bottom of wall difficult.
- ♦ Difficult to ensure backfill quality to meet QA/QC.

The CSM and TC construction methods are capable of cutting through the bedrock to provide the necessary key-in in a single step. The CSM and TC construction methods are very similar, both employing cutting wheels rotating about a horizontal axis. The main difference between TC and the CSM is the manner the cut-off is formed. With the TC method, there is no injection of slurry at the point of cutting. Instead, cutting takes place under a head of bentonite slurry with the cut soils being removed from the trench by pumping to the surface in a suspension of a bentonite slurry. The TC method is usually used where very deep penetration (up to 120 m) in dense or bedrock formation is required. The CSM mixes the in-situ soils with cement-bentonite (SCB) slurry that is injected directly into the soil at the point of cutting. However, the capability of the CSM to penetrate the weathered zone is highly dependent on the strength of the bedrock encountered during construction of the cut-off wall. In the event that the CSM cannot penetrate the weathered zone to construct the cut-off wall key-in, the bottom 2 m (6 feet) of the cut-off wall shall be pressure grouted.

The CSM and TC method also provides a better assurance of quality and performance and has many advantages over the conventional and clamshell method. Based on the soil conditions and depth of the overburden, the CSM method is best suitable at the Project site.

Cut-off Wall Alignment and Location

The general plan arrangement and profiles of the cut-off wall are shown on Figure 2. Typical cross sections through the cut-off wall alignment are provided on Figure 3. The depth of the cut-off wall varies from about 12 m to 20 m below the existing ground surface. The cut-off wall will have a setback distance of 30.5 m (100 feet) from the 100-year, 24-hour flood level, i.e., 212 m. Other environmental features such as cultural resources that could be affected by the pit cut-off wall are also shown on Figure 2.

Cut-off Wall Construction

Figure 4 shows typical construction details of the cut-off wall. The CSM equipment shall be provided with a level platform during excavation of the cut-off trench to ensure verticality. A reinforced concrete guide wall is usually construed first to ensure that the CSM will properly be aligned. The guide wall also provides support of the near surface soil and footings for personnel and equipment. The cut-off wall is constructed in alternative panels. Two primary panels are constructed first. When the soil, cement, and bentonite (SCB) have set, the secondary panel is installed by overlapping into the primary panels, thus providing a continuous wall structure. The CSM is capable of excavating rock. However, in the event that it cannot penetrate unexpected hard formation, the cut-off wall will terminate at the rock surface and that a grout curtain shall be installed in the rock from the bottom of the cut-off wall. The depth of the grout curtain is the same as the embedment depth of the cut-off wall into weathered rock.

Cut-off Wall Mix Design

The cut-off wall will be constructed of soil, cement, and bentonite mix (SCB). Typical bentonite mix content is 6% to 7% of cement by weight and the water/cement ratio shall be between 2 and 3. The final design mix should be determined by suitability tests prior to construction to ascertain that the SCB mix will meet the minimum hydraulic conductivity and a shear strength requirement to meet the final design criteria.

Groundwater Seepage Estimate

Preliminary seepage analyses, based on the proposed cut-off wall profile, approximately 400 m in length indicated the seepage through the cut-off wall ranges from 123 to 4,756 cubic meters per day (32,500 to 125,500 gallons per day [gpd]) during Life of Mine. Further detailed seepage analyses will be carried out in the ongoing project hydrogeological evaluation. Groundwater infiltration and surface water runoff will be collected in sumps located at the lowest operating pit level. Pumps installed in the sumps will pump water to the clarifier ponds located near the Contact Water Basin (CWB). Pump design capacity will be determined with the Project final design upon completion of detailed water seepage analysis.

Overburden Slope Stability

The overburden at the proposed cut-off wall location consists of loose to very dense silty sand to sand and gravel. Pockets of cobles were also encountered at some of the borehole locations. The thickness of the overburden varied from 11 to 21 m. The measured 'N' values from the Standard Penetration Test (SPT) of the overburden varied from 3 to more

than 100 blows per 0.3 m of penetration. Copies of the boring logs from Golder (Golder, 2011) are provided in Attachment 1.

Based on SPT 'N' values and experience of the types of overburden, the geotechnical parameters adopted for slope stability analysis are presented in Table 2.

Table 2
Geotechnical Parameters Used for Slope Stability Analysis

Description of Stratum	Unit Weight (kN/m ³)	Cohesion, c' (kPa)	Internal Friction, ϕ' (degrees)
Overburden	20	0	30
Cut-off Wall	20	500	30
Rock Fill Berm	20	0	36

Prepared by: RXW
Checked by: MJV2

The proposed overburden slope above the bedrock surface is 2H:1V and the toe is located a minimum of 15 m from the crest of the open pit slope. This provides a safe distance from the edge of the pit due to potential development of tension crack on the pit slope. To take into consideration of construction and normal road traffic, a surcharge load of 40 kPa is applied to the top of the slope.

Slope stability analyses were carried out using SLOPE/W software developed by Geo-Slope (Geo-Slope, 2012). The analyses were carried out for the following scenarios:

- ♦ Static short-term condition when the slope is being formed and prior to the construction of the cut-off wall and the phreatic surface is based on the normal water level of the Menominee River.
- ♦ Phreatic surface developed from a steady state flow condition during the 100-year, 24-hour storm with the cut-off wall in place. The raised water level of the Menominee River during the 100-year, 24-hour storm is assumed to be 212 m. For added stability and prevention of sloughing of the overburden slope face, a 3 m wide rock fill toe berm is provided downstream of the overburden slope. The rock fill berm toe is placed directly on bedrock and extended to elevation 210 m. Details of the overburden slope are shown on cross sections presented on Figure 3.

The minimum required factors of safety (FS) for slope stability are as follow:

- ♦ FS during construction of the cut-off wall is 1.25; and
- ♦ Long-term FS during a 100-year, 24-hour storm event is 1.5.

The results of slope stability analysis are provided in Attachment 2. All FS satisfy the minimum required and are summarized as below in Table 3.

Table 3
Summary of Overburden Slope Stability Analysis

Description	FS
Static Short-Term Condition during Construction	27
Static Steady State with a 100-year, 24-hour storm event	1.62
	Prepared by: RXW Checked by: MJV2

Final Design and Construction Considerations

The cut-off alignment will be placed to meet local zoning requirements as well as the project site development needs. The construction of the cut-off wall by the CSM method is often carried out by a specialty contractor. A common design build approach can accept this method based on performance criteria set out by the geotechnical engineer. Additional boreholes will be required at the southern-most portion of the cut-off wall to provide the level of confidence required for final design and tender prior to construction.

Proposed River Road Realignment

River Road is proposed to be realigned around the open pit and cut-off wall during mining operations as shown on Figure 1. This proposal is currently being evaluated by the Menominee County Road Commission. If the proposed route is approved, all permitting will be handled by the Menominee County Road Commission as a separate project. Since wetland WL-14 is proposed to be completely impacted indirectly, and this impact has been addressed in the Proposed Mitigation Plan, any future impact to WL-14 for the River Road reroute (such as 0.05 acres of fill) will have been accounted for in terms of the appropriate amount of mitigation.

East Access Power Corridor

A power corridor to allow additional service to the facility is currently being evaluated by American Transmission Company (ATC). The proposed East Access Power Corridor is shown on Figure 5. If approved, the proper easements and permitting will be completed by ATC under a separate project.

Based on the site reconnaissance and wetland delineation completed on the proposed corridor, there are no wetland impacts that will need to be mitigated. The preliminary wetland assessment for the proposed corridor is included in Appendix B-6 of the Wetlands Permit Application.

References

Foth Infrastructure & Environment, LLC, 2015. *Environmental Impact Assessment, Back Forty Project*. October 2015.

Geo-Slope International, 2012. Calgary, Alberta, Canada.

Golder Associates Inc., 2011. *Cut-off Wall Geotechnical Investigation Factual Report, Back Forty Project*. October 2011.

Tetra Tech, 2014. *Preliminary Economic Assessment of the Back Forty Project, Michigan, USA*. July 23, 2014.

Attachments:

- Figure 1 – Site Location Plan Open Pit and River Road Realignment
- Figure 2 – Cut-off Wall General Arrangement
- Figure 3 – Cut-off Wall Cross Sections
- Figure 4 – Cut-off Wall Typical Details
- Figure 5 – Cut-off Wall, River Road Realignment, and Power Corridor
- Attachment 1 – Boring Logs
- Attachment 2 – Slope Stability Analysis Results

Figures



This legend identifies symbols used in the map to represent different cultural resource locations and boundaries:

- Cultural Resource Locations:
 - Area of Investigation 30m Buffer
 - Designed Pit Perimeter
 - Regulated Wetland
- Boundaries:
 - Non-Regulated Wetland
 - Mineral Property Boundary
 - Project Boundary

10

- NOTES**

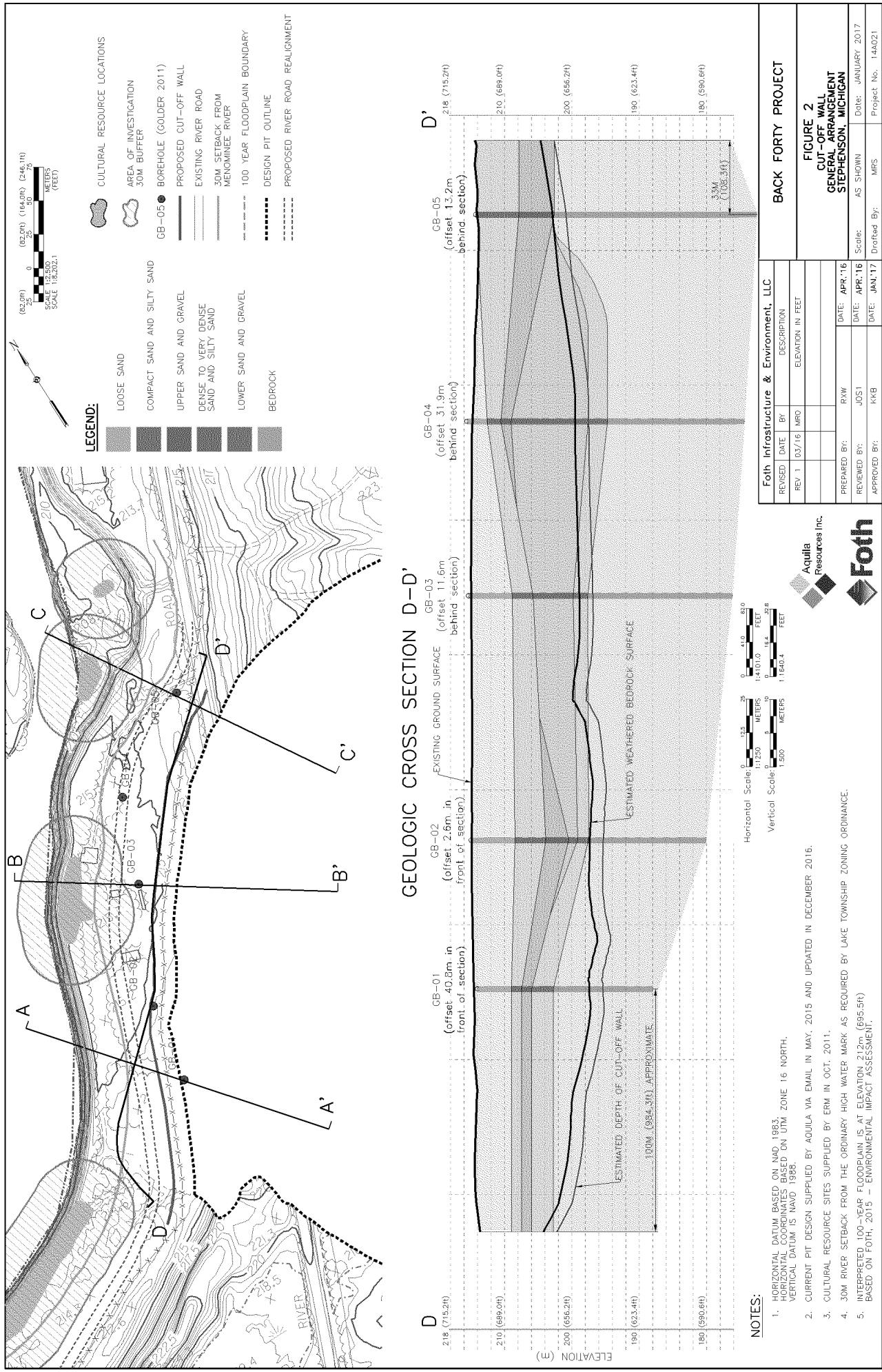
 1. Digital orthophoto imagery, topographic and planimetric data provided by Aero-Metric, Inc., Sheboygan, WI.
 2. Date of acquisition is IDAR-October 31, 2007 and Imagery May 14, 2008.
 3. Horizontal datum based on NAD 1983.
 4. Horizontal coordinates based on UTM Zone 16 Nor. th.
 5. Wetlands created from combined field surveys suppled EWR in June 2011 and Stanite in August 2015, July 2016 and September 2016.
 6. Current pit design supplied by Aquila via email in May 2016 and updated in December 2016.
 7. Cultural resources findings supplied by CCRG in October 2016.

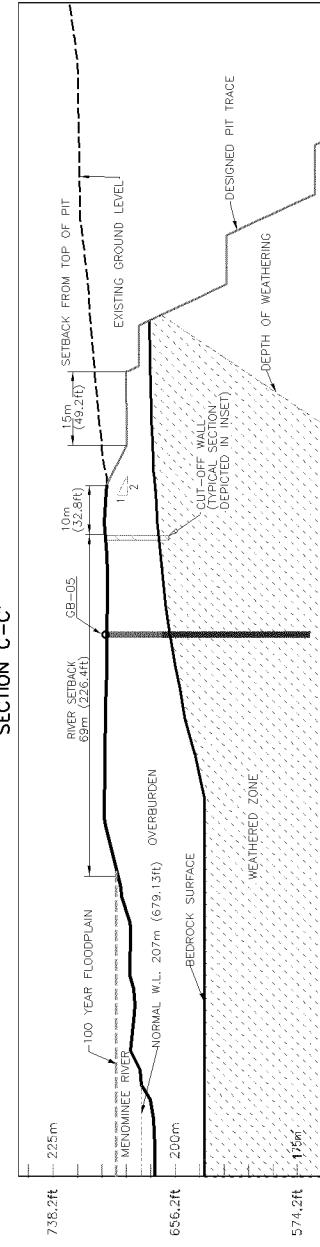
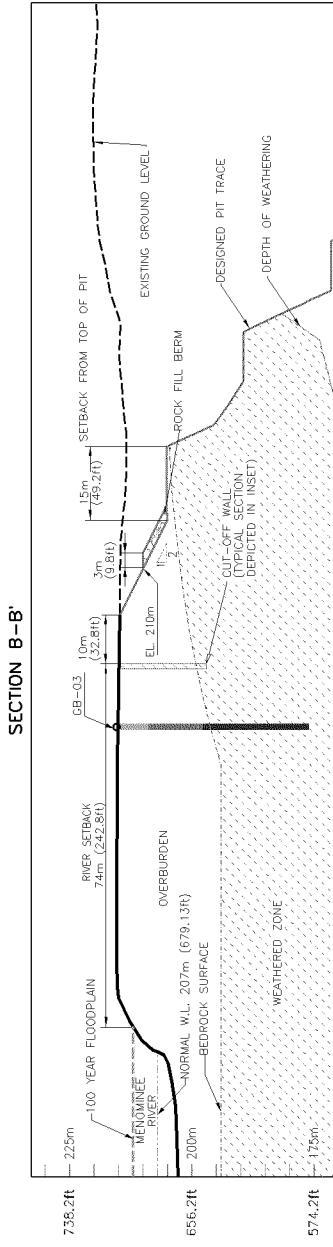
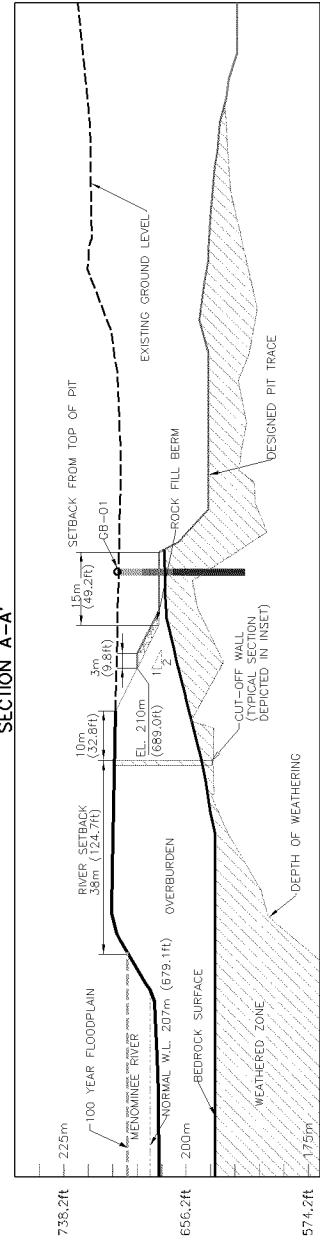
NOTES

BACK FORTY PROJECT

FIGURE 1
SITE LOCATION PLAN
T AND RIVER ROAD REALIGNMENT
STEPHENSON, MICHIGAN

Project No.: 14
Date: JANUARY
Fees:



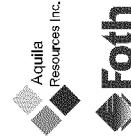


SECTION A-A'

NOTE

1. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH. VERTICAL DATUM IS NAVD 1988.
 2. CURRENT PIT DESIGN SUPPLIED BY AQUILA VIA EMAIL IN MAY, 2015.
 3. CULTURAL RESOURCE SITES SUPPLIED BY ERM IN OCT. 2011.
 4. 30M RIVER SETBACK FROM THE HIGH WATER LEVEL AS REQUIRED BY LAKE TOWNSHIP ZONING ORDINANCE.
 5. ORDINARY HIGH-WATER MARK IS ASSUMED TO BE THE 100-YEAR, 24-HOUR FLOOD LEVEL.
 6. 20M RIGHT-OF-WAY AS REQUIRED BY LAKE TOWNSHIP ORDINANCE.
 7. CROSS SECTION LOCATIONS SHOWN ON FIGURE 2.
 8. INTERPRETED 100-YEAR FLOODPLAIN IS AT ELEVATION 212m (695.5ft) BASED ON FOT, ENV-1 Cut-Off Wall Section and EnviroCAD 2016 Figure 3 Cut-Off Wall Section and EnviroCAD 2016 Figure 4A021-001-CARDON Dues

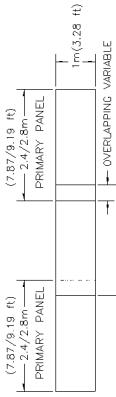
Footh Infrastructure & Environment, LLC				BACK FORTY PROJECT			
REVISED DATE	BY	DESCRIPTION		REV 1	03 / 16	MFRD	ELEVATION IN FEET
PREPARED BY:	R.W.W.			DATE:	MAR 16		
REVIEWED BY:	JOS 1			DATE:	MAR 16		
APPROVED BY:	KTB			DATE:	JAN 17	Drafted By:	AS SHOWN
				DATE:	JAN 17	MFRS	Project No.: 144021
				FIGURE 3 CUT-OFF WALL CROSS SECTIONS STEPHENVILLE, MICHIGAN			
				JANUARY 2017			



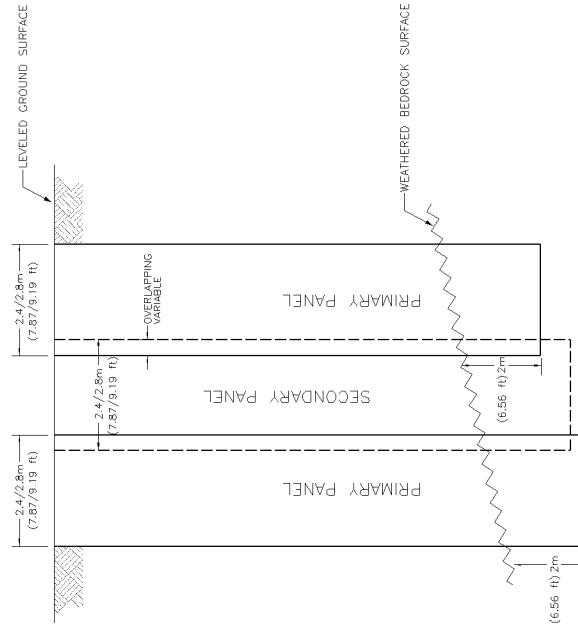
ג' ינואר 2013

CUT-OFF WALL
CROSS SECTIONS
STEPHENSON, MICHIGAN

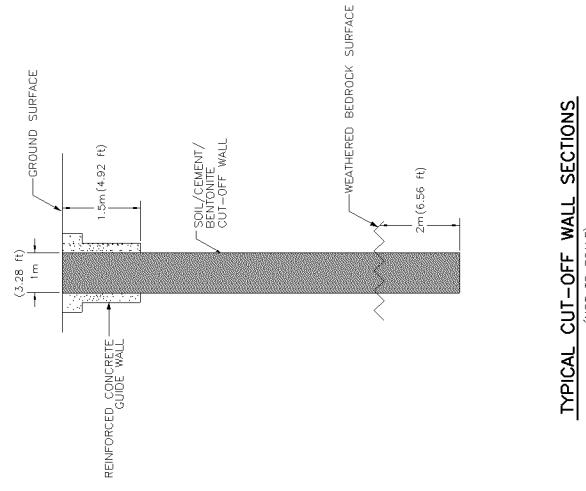
AS SHOWN Date: JANUARY



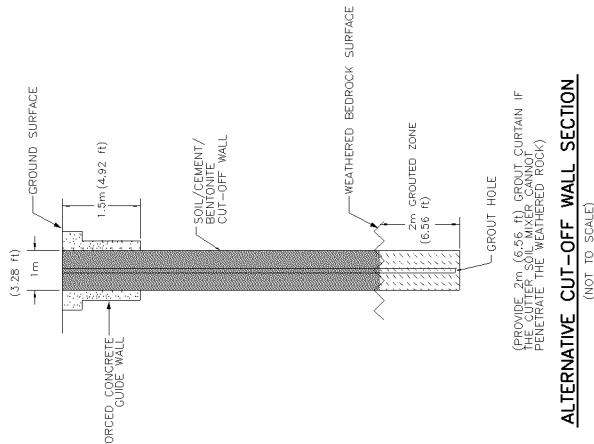
CUT-OFF WALL CONSTRUCTION SEQUENCE – PLAN VIEW
(NOT TO SCALE)



CUT-OFF WALL CONSTRUCTION SEQUENCE – SECTION VIEW
(NOT TO SCALE)



TYPICAL CUT-OFF WALL SECTIONS
(NOT TO SCALE)



ALTERNATIVE CUT-OFF WALL SECTION
(NOT TO SCALE)

NOTES:

1. THE CUT-OFF WALL IS TO BE CONSTRUCTED USING CUTTER SOIL MIXER (CSM) METHOD.
2. A LEVEL PLATFORM SHALL BE PROVIDED FOR THE CSM TO ENSURE VERTICALITY.
3. THE FINAL DESIGN MIX SHOULD BE DETERMINED BY SUITABILITY TESTS PRIOR TO CONSTRUCTION TO MEET THE MINIMUM HYDRAULIC CONDUCTIVITY AND A SHEAR STRENGTH REQUIREMENT.
4. MIX PORTIONS MAY BE ADJUSTED TO PROVIDE WORKABILITY.
5. THE CONSTRUCTION OF THE CUT-OFF WALL SHALL BE SUPERVISED BY A QUALIFIED GEOTECHNICAL ENGINEER.

N:\PROJECT\2014\44021-30\CAD\COW\000\2016\Figure 4 Cut-off Wall Detail.dwg
1/5/2017

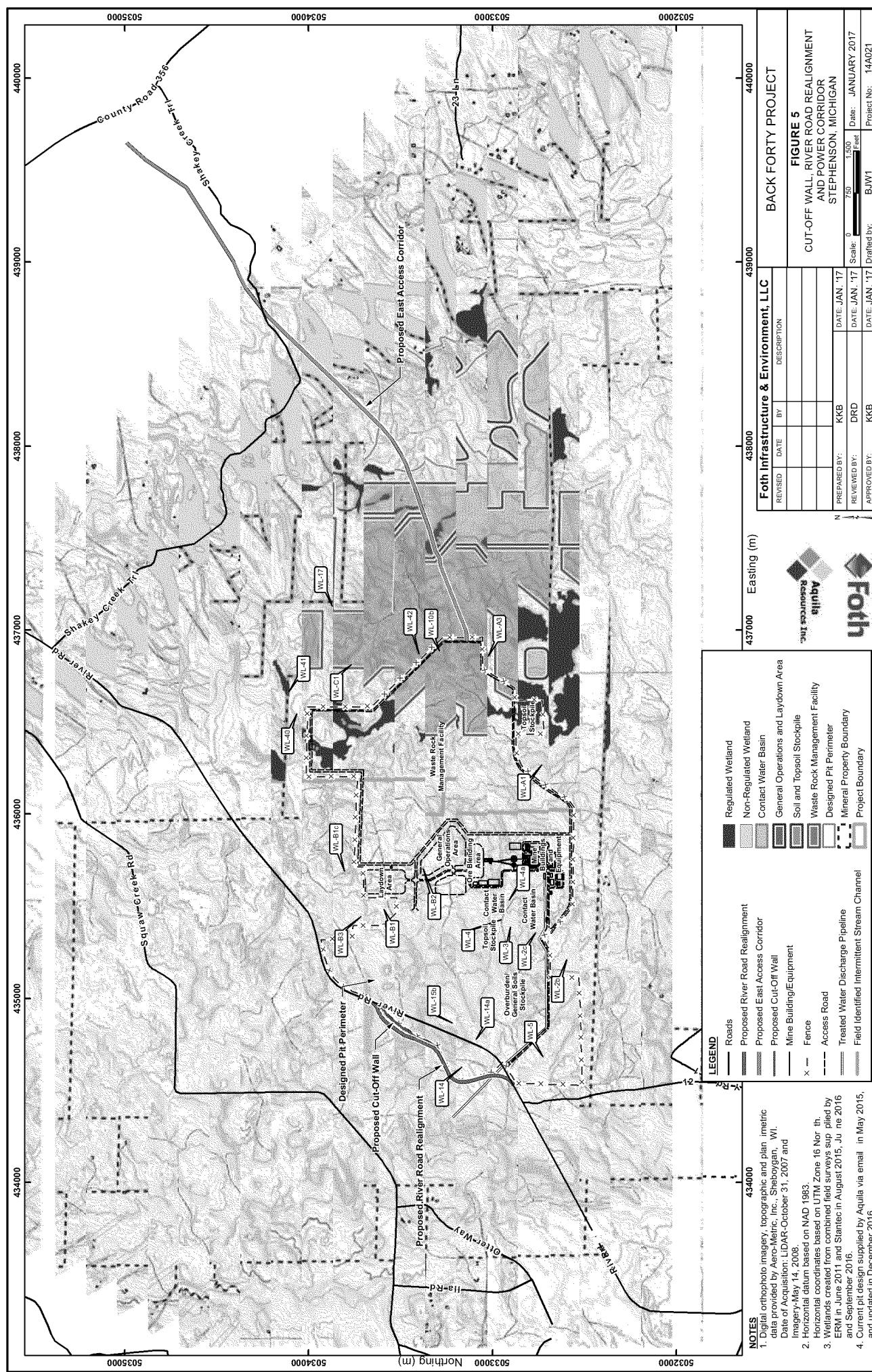
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2. A LEVEL PLATFORM SHALL BE PROVIDED FOR THE CSM TO ENSURE VERTICALITY.
3. THE FINAL DESIGN MIX SHOULD BE DETERMINED BY SUITABILITY TESTS PRIOR TO CONSTRUCTION TO MEET THE MINIMUM HYDRAULIC CONDUCTIVITY AND A SHEAR STRENGTH REQUIREMENT.
4. MIX PORTIONS MAY BE ADJUSTED TO PROVIDE WORKABILITY.
5. THE CONSTRUCTION OF THE CUT-OFF WALL SHALL BE SUPERVISED BY A QUALIFIED GEOTECHNICAL ENGINEER.

Foth Infrastructure & Environment, LLC
REVISED DATE BY DESCRIPTION

BACK FORTY PROJECT
REVISED DATE BY DESCRIPTION

FIGURE 4
CUT-OFF WALL
TYPICAL DETAILS
STEPHENSON, MICHIGAN
AS SHOWN
DRAFTED BY: JOW
DATE: JANUARY 2017
Project No. 144021





Attachment 1

Boring Logs

PROJECT: 10-113-003

RECORD OF Borehole: GB-01

SHEET 1 OF 2

LOCATION: N5033376.66 E 434754.03

BORING DATE: AUG 34, 2011

DATUM:

SAMPLE HAMMER, 64kg, DROP, 750mm

PENETRATION TEST HAMMER, 64kg, DROP, 750mm

DEPTH SCALE METERS	BORING METHOD	SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOWCOUNT				HYDRAULIC CONDUCTIVITY, K, CM/H				ADDITIONAL LAB TESTING	PIROMETER OR STANDPIPE INSTALLATION						
		STRATA/PILOT	ELEV. DEPTH MTR		NUMBER	TYPE	BLOWCOUNT, 50cm	20	40	60	80	100	120	140	160	180	200	220	240	260
0		GROUND SURFACE	214.00																	
1		Loose, brown, SAND, trace gravel, trace SIL.	209.00																	
2			208.00																	
3			207.00																	
4			206.00																	
5			205.00																	
6		Compact, reddish brown, Silty SAND, some gravel, some clay	204.00																	
7			203.00																	
8		Compact, reddish-brown, angular GRAVEL and COBBLES	202.00																	
9			201.00																	
10		Very dense, reddish-brown, SAND and GRAVEL, some silt, trace to some clay	200.00																	
		CONTINUED NEXT PAGE																		

GITA BBS-001-100-100-0001-G03-GAUSUS007-101811 ET

DEPTH SCALE

1:50



LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Borehole: GB-01

SHEET 2 OF 2

LOCATION: N 5033376.66, E 434794.09

BORING DATE: AUG 3-4, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BOILING METHOD	SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION			
		DESCRIPTION	STRATA/PILOT		ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	20	40	60	80	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²	
10	152 mm POWER AUGER	...CONTINUED FROM PREVIOUS PAGE -- Very dense, reddish-brown, SAND and GRAVEL, some silt, trace to some clay															
11					202.73												
11		END OF HOLE			11.30												
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	

GTA-BHS 007-10-1193-0003.GPJ GAL-MIS.GDT 10/18/11 ET

DEPTH SCALE

1 : 50



LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Borehole: GB-02

SHEET 1 OF 2

LOCATION: N 5033435.02 E 434804.80

BORING DATE: AUG 6-8, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BOREHOLE METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
							20	40	60	80	10 ⁻⁵	10 ⁻⁴	10 ⁻³	10 ⁻²		
0		GROUND SURFACE Loose, brown, SAND		214.98 0.00												
1																
2																
3																
4																
5	152 mm POWER AUGER															
6																
7		758 mm ID. HOLLOW STEM 08/08/2011 Compact, brown, SAND, some gravel; trace to some silt to SAND and GRAVEL, trace silt		208.42 6.55	4	DO										M
8					5											
9					6											
10					7											
11					8											
12					9											
13					10											
14																
15																

CONTINUED NEXT PAGE

GTA-BHS 001-10-1193-0003.GPJ GAL-MIS.GDT 10/18/11 ET

DEPTH SCALE

1 : 60



LOGGED: ES

CHECKED:

PROJECT: 10-1183-0003		RECORD OF Borehole: GB-02										SHEET 2 OF 2				
LOCATION: N 5033435.02 ; E 434804.80		BORING DATE: AUG 6-8, 2011										DATUM:				
SAMPLER HAMMER, 64kg; DROP, 760mm		PENETRATION TEST HAMMER, 64kg; DROP, 760mm														
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m			HYDRAULIC CONDUCTIVITY, K, cm/s					
		DESCRIPTION			STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	20	40	60	80	10 ⁴	10 ⁴	10 ³	10 ²
									SHEAR STRENGTH Cu, kPa	nat V. + rem V. @ C - C	Wp	W	Wt	Wt	Wt	
10		<i>-- CONTINUED FROM PREVIOUS PAGE --</i>														
10		Compact, brown, SAND, some gravel, trace to some silt to SAND and GRAVEL, trace silt														
11	152 mm POWER AUGER					203.85	7	DO		17						
11		Very dense, brown, SAND and GRAVEL, some cobbles				11.13	8	DO		67						
12																
13																
14																
14	ROTARY DRILL					200.50	9	DO	>100							
14		Very dense, light brown, SAND with SILT, trace to some clay				14.40	10	DO								
15																
15		Very dense, brown, SAND and GRAVEL, some cobbles				199.13	11	DO	>100							
15						15.65										
16																
16																
17						197.51										
17		END OF HOLE				17.47										
18																
19																
20																

GTA-BHS 001 10-1183-0003.GPJ GAL-MIS.GDT 10/18/11 ET

DEPTH SCALE
1 : 50LOGGED: ES
CHECKED:

PROJECT: 10-1193-0003

RECORD OF Borehole: GB-03

SHEET 1 OF 2

LOCATION: N 6033516.78 ;E 434844.79

BORING DATE: AUG 11-12, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

GTA-BHS 001 10-1193-0003.CPJ GAL-MISS.GDT 10/18/11 ET

DEPTH SCALE

1 : 50



LOGGED: ES

CHECKED:

RECORD OF Borehole: GB-03										SHEET 2 OF 2			
BORING DATE: AUG 11-12, 2011										DATUM:			
SAMPLE HAMMER, 64kg; DROP, 760mm										PENETRATION TEST HAMMER, 64kg; DROP, 760mm			
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, K, cm/s		PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION		STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	20 Cu, kPa	40 nat V. + rem V. \oplus	60 Q - O - C	80 Wp \downarrow W \downarrow WI	10 ⁰ 10 ¹ 10 ²
10	ROTARY DRILL	<i>-- CONTINUED FROM PREVIOUS PAGE --</i> Dense to very dense, brown, SAND, trace to some silt										M	
11	ROTARY DRILL	400mm CASING ADVANCED 08/2011											
12	ROTARY DRILL	400mm CASING ADVANCED 08/2011											
13	ROTARY DRILL	Very dense, light brown, SAND, some silt, trace to some clay											
14	ROTARY DRILL	Very dense, light brown, SAND, some silt, trace to some clay											
15	ROTARY DRILL	Very dense, light brown, SAND, some silt, trace to some clay											
16	ROTARY DRILL	GRAVEL and COBBLES											
17	ROTARY DRILL	GRAVEL and COBBLES											
18	ROTARY DRILL	END OF HOLE											
19	ROTARY DRILL												
20	ROTARY DRILL												

GTA-SHS 001 10-1193-0003.GPJ GAL-MIS.GDT 10/18/11 ET

DEPTH SCALE
1:50LOGGED: ES
CHECKED:

PROJECT: 10-1183-0003

RECORD OF Borehole: GB-04

SHEET 1 OF 3

LOCATION: N 5033577.28 E 434869.92

BORING DATE: AUG 18-17, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, K, mm/h				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
					20	40	60	80	10 ³	10 ⁴	10 ⁵	10 ⁶			
		STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH CU, kPa	nat V, + Q- O-	rem V, - Q+ O-	Wp	W	Wf			
0		GROUND SURFACE	215.58 0.00												
1		Loose, brown, SAND, some gravel													
2															
3		Very loose to compact, brown, SAND, trace gravel, trace to some silt	212.81 3.05	1	DO	4									
4				2	DO	3									
5	-52 mm POWER AUGER			3	DO	22									
6	103 mm I.D. HOLLOW STEM AUGER	Very dense, brown, SAND and GRAVEL, trace to some silt	210.58 5.03	4	DO	61									M
7		Dense to loose, brown, Silty SAND, trace to some clay to SAND, trace to some gravel, trace to some silt, trace to some clay	209.04 6.56	5	DO	37									N
8				6	DO	41									MH
9				7											MH
10				8											

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GTA-BMS 0014 10-1183-0003.GP4 GAL-MIS.GDT 10/18/11 ET

DEPTH SCALE

1 : 50



LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Borehole: GB-04

SHEET 2 OF 3

LOCATION: N 5033577.28; E 434869.92

BORING DATE: AUG 16-17, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION			
		DESCRIPTION	STRATA PLOT		ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa	nat V. + O. ●	rem V. + U. ○	Wp ↓	W ↓	10 ⁻⁶	10 ⁻¹	10 ⁻²	10 ⁻³
<i>-- CONTINUED FROM PREVIOUS PAGE --</i>																	
10		Dense to loose, brown, Silty SAND, trace to some clay to SAND, trace to some gravel, trace to some silt, trace to some clay				7	DO	8									
11		Very dense, brown, Silty SAND, trace gravel, trace to some clay	204.46			8	DO	60									
12	ROTARY DRILL																
13		102' FT CASING ADVANCE (308.02m)															MFT
14																	
15																	
16																	
17	ROTARY DRILL																
18		NO CORE (309.02m)															
19																	
20		Very dense, brown, SAND and GRAVEL, trace to some silt, trace to some clay	197.61 17.98			11	DO	83									M
						12	DO	100									
<i>CONTINUED NEXT PAGE</i>																	

GTA-BHS 001 10-1193-0003 GPS 4 GAU-MIS.GDT 10/18/11 ET

DEPTH SCALE

1 : 50



LOGGED: ES

CHECKED:

PROJECT: 10-1183-0003

RECORD OF Borehole: GB-04

SHEET 3 OF 3

LOCATION: N 5033577.28; E 434889.92

BORING DATE: AUG 16-17, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOW/S/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA PILOT	ELEV. DEPTH (m)		NUMBER	TYPE	SHIEAR STRENGTH Cu, kPa						
								20	-10	60	80	Q - ●	U - ○	
20	ROTARY DRILL NO CORES SUB 2011	— CONTINUED FROM PREVIOUS PAGE — Very dense, brown, SAND and GRAVEL, trace to some silt, trace to some clay		194.69										
21		END OF HOLE		20.90										
22														
23														
24														
25														
26														
27														
28														
29														
30														

GTA-BHS 001 10-1183-0003.GPJ GAL-MIS.GDT 10/18/11 ET

DEPTH SCALE

1 : 50



LOGGED: ES

CHECKED:

PROJECT: 10-1183-0003

RECORD OF Borehole: GB-05

SHEET 1 OF 2

LOCATION: N 5033620.44 ; E 434945.71

BORING DATE: AUG 19-20, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m					HYDRAULIC CONDUCTIVITY, K, cm/s					ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT		ELEV. DEPTH (m)	NUMBER	TYPE	20	40	60	80	10 ⁵	10 ⁴	10 ³	10 ²		
					SHEAR STRENGTH Cu, kPa	res V. + Q. -	rom V. ⊕ U. - O.		Wp	F	W	I	WI				
0	GROUND SURFACE	214.27	0.00														
0	Compact, brown, Silty SAND, some gravel, trace clay																
1																	
2																	
3	Compact, brown, SAND, some gravel, trace to some clay	211.84	7.44														
4																	
5																	
6																	
7	Very dense, SAND and GRAVEL, trace to some silt, trace to some clay	207.87	6.40	2	DO	29										M	18/08/2011
8																	
9																	
10	ROTARY DRILL																
CONTINUED NEXT PAGE																	

GTA-SHS 001 10-1193-0003.GPJ GALANS.GDT 10/18/11 ET

DEPTH SCALE

1 : 50



LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Borehole: GB-05

SHEET 2 OF 2

LOCATION: N 5033620.44 ; E 434945.71

BORING DATE: AUG 19-20, 2011

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION		
		DESCRIPTION	STRATA/FLCT		ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	20	40	60	80	10 ⁰	10 ⁻¹	10 ⁻²	
10	ROTARY DRILL	— CONTINUED FROM PREVIOUS PAGE — Very dense, SAND and GRAVEL, trace to some silt, trace to some clay														
11	400 mm CASING ADVANCE 18082011				202.62	7	DD	80								
12		END OF HOLE			11.65											
13																
14																
15																
16																
17																
18																
19																
20																

GTA-BHS 001 10-1193-0003 GPJ GAL-MIS.GDT 10/18/11 ET

DEPTH SCALE
1 : 50LOGGED: ES
CHECKED:

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-01

SHEET 1 OF 2

LOCATION: N 6033376.7 ;E 434794.1

DRILLING DATE: AUG 3-4, 2011

DATUM:

INCLINATION: -90° AZIMUTH: ...

DRILL RIG: D-120

DRILLING CONTRACTOR: Clemen Engineering Co.

DEPTH SCALE METRES	DEPTH SCALE METRES	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	FLUID REURN	JN - Joint FLT - Fault SHR - Shear VN - Vain CJ - Conjugate	BD - Bedding FO - Foliation CO - Contorted OR - Orthogonal CL - Cleavage	PL - Planar CV - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensidered SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock	NOTES: For additional information refer to the specifications & symbols	FEATURES	NOTES
		Continued from Record of Borehole GB-01		202.73										
11	11.30 - 26.03 m	Moderately weathered, foliated, dark bluish grey and dark reddish brown, fine grained, weak to medium strong, sheared RHYOLITE CRYSTAL TUFF (RCTF), containing fine to medium grained quartz eyes	XXV	202.26	3									
12	-Moderate silification to 15.74 m, weak to moderate sericitic/chlorite alteration	-Strong oxidation throughout Interval			4									
13					5									
14					6									
15					7									
16					8									
17	17.50 - 20.5 m	Very fine grained, disseminated Iron-oxide in pitted/vuggy areas			9									
18					10									
19	19.64 - 20.08 m	Lapilli tuff												
20														
21														

CONTINUED NEXT PAGE

GTA-RCK-030 10-1193-0003.GPR CAL/MISS.CDF 9/28/11 ET

DEPTH SCALE

1 : 50



LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-01

SHEET 2 OF 2

LOCATION: N 5033376.7 ; E 434784.1

DRILLING DATE: AUG 3-4, 2011

DATUM:

INCLINATION: -90° AZIMUTH: --

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DEPTH RECORD	DESCRIPTION	SYNTHETIC LOG	ELEV. (m)	RUN No.	FLUSH RETURN	JN - Joint	BD - Bedding	PL - Planar	PO - Polished	BR - Broken Rock	NOTES
							FLT - Fault	FO - Foliation	CJ - Curved	K - Skewed	SM - Smooth	
DEPTH	DEPTH	RECOVERY	FRACT.	DISCONTINUITY DATA	HYDRAULIC CONDUCTIVITY	WEATH- ERING INDEX						
(m)	(m)	TOTAL CORE %	R.D. %	INDEX PER Metre Core %	K, cm/sec	10^-4	10^-4	10^-4	10^-4	10^-4	10^-4	10^-4
0000	0000	SIERRA	SIERRA	SIERRA	SIERRA	SIERRA	SIERRA	SIERRA	SIERRA	SIERRA	SIERRA	SIERRA
-- CONTINUED FROM PREVIOUS PAGE ...												
11.30 - 26.03 m		Moderately weathered, foliated, dark bluish grey and dark reddish brown, fine grained, weak to medium strong, sheared RHYOLITE CRYSTAL TUFF (RCTF), containing fine to medium grained quartz eyes	X	10								
		- Moderate silification to 15.74 m, weak to moderate sericite/clay alteration	X	11								
		- Strong oxidation throughout interval	X									
21.46 - 22.95 m		Dark grey, chlorite filled veinlets present	X									
22.60 - 22.80 m		Shear zone, dipping 35° to core axis	X									
NO-3 BBL NO Rocks												
Take Two Samples												
END OF DRILLHOLE				108.03	26.03							
27												
28												
29												
30												
31												

GIA-RCK 030 10-1193-0003.GPI GAL-MISS.GGT 9/29/11 ET

DEPTH SCALE
1 : 50

LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-02

SHEET 1 OF 2

LOCATION: N 5933435.0 ; E 434804.8

DRILLING DATE: AUG 8-8, 2011

DATUM:

INCLINATION: -90° AZIMUTH: -

DRILL RIG: D-126

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LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-02

SHEET 2 OF 2

LOCATION: N 603435.0 ; E 434804.8

DRILLING DATE: AUG 6-8, 2011

DATUM:

INCLINATION: -80° AZIMUTH: --

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DEPTH RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY	R.O.D. %	TOTAL CORE % SPER	FRACTION CORE % PER Metres	CB W.C. CORE AND SPER	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY K (cm/ sec)	WEATH- ERING INDEX	FEATURES	NOTES		
												JN	BD	PL	PO	BR				
-- CONTINUED FROM PREVIOUS PAGE --																				
26		27.67 - 31.02 m Slightly weathered to fresh, massive, very light grey to dark grey, fine to coarse grained, faintly porous, medium strong RHYOLITE CRYSTAL TUFF (RCTF)		187.30 27.68	9															
27																				
28																				
29																				
30																				
31	NOS B/L IN RECS Traces of Shearing	31.02 - 33.55 m Flesh, bedded, light bluish grey to medium grey, fine to medium grained, non-porous, medium strong TUFFACEOUS SEDIMENTS (TFSD) - Moderate silification - Some pale yellow irregular siliceous veinlets		183.98 31.02	11															
32																				
33																				
34		33.55 - 34.87 m Fresh, foliated, greylsh black and moderate olive brown, fine to medium grained, faintly to moderately porous, medium strong, MASSIVE SULPHIDE (MASU), containing sub-hedral, fine grained pyrite with sphalerite in slightly dipping, undulating bands - Slightly brecciated texture and randomly oriented micro-defects		183.43 33.55	12															
35		END OF DRILLHOLE		180.11 34.87	13															
36																				
37																				
38																				
39																				
40																				

GIA-ROCK 030 10-1193-0003.GPJ GAL-MISS.GDT 5/29/11 ET

DEPTH SCALE

1 : 60



LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-03

SHEET 1 OF 3

LOCATION: N 6033516.8 ; E 434844.8

DRILLING DATE: AUG 11-12, 2011

DATUM:

INCLINATION: -90° AZIMUTH: —

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYNTHETIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	JN - Joint FLT - Fault SHR - Shear VN - Volt CJ - Conjugate	BO - Bedding FO - Foliation CO - Contact OR - Orthogonal CI - Change	PL - Planar CU - Curved UN - Undulating ST - Sloped IR - Irregular	PC - Polished K - Slickensided SM - Smooth RO - Rough	BL - Broken Rock NOTE: Fracture above/below total or subhorizontal & vertical	NOTES		
17.71		Continued from Record of Borehole GB-03		187.68										
17.71		17.71 - 39.20 m Slightly to moderately weathered, massive to foliated, medium dark grey to dark reddish brown, aphanitic to medium grained, non-porous, medium strong to strong, RHYOLITE CRYSTAL TUFF (RCTF) · Moderately silicified, medium to coarse grained quartz eyes and oxidation throughout · 15% disseminated very fine grained pyrite zone from 18.17 - 18.38 m		17.71	1									
18					2									
19					3									
20					4									
21					5									
22					6									
23	XO-3 B67 NO Roads Title-Title Sampling				7									
24					8									
25														
26														
27														
		CONTINUED NEXT PAGE												

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-03

SHEET 2 OF 3

LOCATION: N 5033516.8 ;E 434844.8

DRILLING DATE: AUG 11-12, 2011

DATUM

INCLINATION: -90°

DRILL RIG: D-120

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1:50

PROJECT: 10-1183-0003

RECORD OF Drillhole: GB-03

SHEET 3 OF 3

LOCATION: N 5033616.8 ; E 434844.8

DRILLING DATE: AUG 11-12, 2011

DATUM:

INCLINATION: -90° AZIMUTH: --

DRILL RIG: D-12

DRILLING CONTRACTOR: Coleman Engineering Co.

STANZA 030 13-1133-0003-001 001 ACCESS UNIT 8/29/11 ET

DEPTH SCALE

t : 50

 Golder
Associates

LOGGED: ES

CHECKED:

PROJECT: 10-1183-0003

RECORD OF Drillhole: GB-04

SHEET 1 OF 3

LOCATION: N 5033577.3 , E 434869.9

DRILLING DATE: AUG 16-17, 2011

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DATUM:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. (m)	RUN NO.	PLUG/REFURN	RECOVERY %	R.O.D. %	PRACTIC INDEX PER MOTOR 240V	DIP/PL CORE 200 280	DISCONTINUITY DATA	HYDRAULIC CONDUCTIVITY K, cm/sec	WEAT- HING INDEX	BR - Broken Pack	FEATURES	NOTES
TOTAL CORE %	SOLID CORE %	TYPE AND SURFACE DESCRIPTION	J1 J2 J3 J4 J5 J6 J7 J8 J9 J10 J11 J12 J13 J14 J15 J16 J17 J18 J19 J20 J21 J22 J23 J24 J25 J26 J27 J28 J29 J30 J31 J32 J33 J34 J35 J36 J37 J38 J39 J40 J41 J42 J43 J44 J45 J46 J47 J48 J49 J50 J51 J52 J53 J54 J55 J56 J57 J58 J59 J60 J61 J62 J63 J64 J65 J66 J67 J68 J69 J70 J71 J72 J73 J74 J75 J76 J77 J78 J79 J80 J81 J82 J83 J84 J85 J86 J87 J88 J89 J90 J91 J92 J93 J94 J95 J96 J97 J98 J99 J100 J101 J102 J103 J104 J105 J106 J107 J108 J109 J110 J111 J112 J113 J114 J115 J116 J117 J118 J119 J120 J121 J122 J123 J124 J125 J126 J127 J128 J129 J130 J131 J132 J133 J134 J135 J136 J137 J138 J139 J140 J141 J142 J143 J144 J145 J146 J147 J148 J149 J150 J151 J152 J153 J154 J155 J156 J157 J158 J159 J160 J161 J162 J163 J164 J165 J166 J167 J168 J169 J170 J171 J172 J173 J174 J175 J176 J177 J178 J179 J180 J181 J182 J183 J184 J185 J186 J187 J188 J189 J190 J191 J192 J193 J194 J195 J196 J197 J198 J199 J200 J201 J202 J203 J204 J205 J206 J207 J208 J209 J210 J211 J212 J213 J214 J215 J216 J217 J218 J219 J220 J221 J222 J223 J224 J225 J226 J227 J228 J229 J229 J230 J231 J232 J233 J234 J235 J236 J237 J238 J239 J239 J240 J241 J242 J243 J244 J245 J246 J247 J248 J249 J249 J250 J251 J252 J253 J254 J255 J256 J257 J258 J259 J259 J260 J261 J262 J263 J264 J265 J266 J267 J268 J269 J269 J270 J271 J272 J273 J274 J275 J276 J277 J278 J279 J279 J280 J281 J282 J283 J283 J284 J285 J285 J286 J286 J287 J287 J288 J288 J289 J289 J290 J290 J291 J291 J292 J292 J293 J293 J294 J294 J295 J295 J296 J296 J297 J297 J298 J298 J299 J299 J300 J300 J301 J301 J302 J302 J303 J303 J304 J304 J305 J305 J306 J306 J307 J307 J308 J308 J309 J309 J310 J310 J311 J311 J312 J312 J313 J313 J314 J314 J315 J315 J316 J316 J317 J317 J318 J318 J319 J319 J320 J320 J321 J321 J322 J322 J323 J323 J324 J324 J325 J325 J326 J326 J327 J327 J328 J328 J329 J329 J330 J330 J331 J331 J332 J332 J333 J333 J334 J334 J335 J335 J336 J336 J337 J337 J338 J338 J339 J339 J340 J340 J341 J341 J342 J342 J343 J343 J344 J344 J345 J345 J346 J346 J347 J347 J348 J348 J349 J349 J350 J350 J351 J351 J352 J352 J353 J353 J354 J354 J355 J355 J356 J356 J357 J357 J358 J358 J359 J359 J360 J360 J361 J361 J362 J362 J363 J363 J364 J364 J365 J365 J366 J366 J367 J367 J368 J368 J369 J369 J370 J370 J371 J371 J372 J372 J373 J373 J374 J374 J375 J375 J376 J376 J377 J377 J378 J378 J379 J379 J380 J380 J381 J381 J382 J382 J383 J383 J384 J384 J385 J385 J386 J386 J387 J387 J388 J388 J389 J389 J390 J390 J391 J391 J392 J392 J393 J393 J394 J394 J395 J395 J396 J396 J397 J397 J398 J398 J399 J399 J400 J400 J401 J401 J402 J402 J403 J403 J404 J404 J405 J405 J406 J406 J407 J407 J408 J408 J409 J409 J410 J410 J411 J411 J412 J412 J413 J413 J414 J414 J415 J415 J416 J416 J417 J417 J418 J418 J419 J419 J420 J420 J421 J421 J422 J422 J423 J423 J424 J424 J425 J425 J426 J426 J427 J427 J428 J428 J429 J429 J430 J430 J431 J431 J432 J432 J433 J433 J434 J434 J435 J435 J436 J436 J437 J437 J438 J438 J439 J439 J440 J440 J441 J441 J442 J442 J443 J443 J444 J444 J445 J445 J446 J446 J447 J447 J448 J448 J449 J449 J450 J450 J451 J451 J452 J452 J453 J453 J454 J454 J455 J455 J456 J456 J457 J457 J458 J458 J459 J459 J460 J460 J461 J461 J462 J462 J463 J463 J464 J464 J465 J465 J466 J466 J467 J467 J468 J468 J469 J469 J470 J470 J471 J471 J472 J472 J473 J473 J474 J474 J475 J475 J476 J476 J477 J477 J478 J478 J479 J479 J480 J480 J481 J481 J482 J482 J483 J483 J484 J484 J485 J485 J486 J486 J487 J487 J488 J488 J489 J489 J490 J490 J491 J491 J492 J492 J493 J493 J494 J494 J495 J495 J496 J496 J497 J497 J498 J498 J499 J499 J500 J500 J501 J501 J502 J502 J503 J503 J504 J504 J505 J505 J506 J506 J507 J507 J508 J508 J509 J509 J510 J510 J511 J511 J512 J512 J513 J513 J514 J514 J515 J515 J516 J516 J517 J517 J518 J518 J519 J519 J520 J520 J521 J521 J522 J522 J523 J523 J524 J524 J525 J525 J526 J526 J527 J527 J528 J528 J529 J529 J530 J530 J531 J531 J532 J532 J533 J533 J534 J534 J535 J535 J536 J536 J537 J537 J538 J538 J539 J539 J540 J540 J541 J541 J542 J542 J543 J543 J544 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J944 J945 J945 J946 J946 J947 J947 J948 J948 J949 J949 J950 J950 J951 J951 J952 J952 J953 J953 J954 J954 J955 J955 J956 J956 J957 J957 J958 J958 J959 J959 J960 J960 J961 J961 J962 J962 J963 J963 J964 J964 J965 J965 J966 J966 J967 J967 J968 J968 J969 J969 J970 J970 J971 J971 J972 J972 J973 J973 J974 J974 J975 J975 J976 J976 J977 J977 J978 J978 J979 J979 J980 J980 J981 J981 J982 J982 J983 J983 J984 J984 J985 J985 J986 J986 J987 J987 J988 J988 J989 J989 J990 J990 J991 J991 J992 J992 J993 J993 J994 J994 J995 J995 J996 J996 J997 J997 J998 J998 J999 J999 J1000 J1000 J1001 J1001 J1002 J1002 J1003 J1003 J1004 J1004 J1005 J1005 J1006 J1006 J1007 J1007 J1008 J1008 J1009 J1009 J1010 J1010 J1011 J1011 J1012 J1012 J1013 J1013 J1014 J1014 J1015 J1015 J1016 J1016 J1017 J1017 J1018 J1018 J1019 J1019 J1020 J1020 J1021 J1021 J1022 J1022 J1023 J1023 J1024 J1024 J1025 J1025 J1026 J1026<br													

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-04

SHEET 2 OF 3

LOCATION: N 5033577.3 E 434869.9

DRILLING DATE: AUG 16-17, 2011

INCLINATION: -90° AZIMUTH: --

DRILL RIG: D-120

DATUM:

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYNTHETIC LOG	ELEV. DEPTH (M)	RCN NO.	FLUSH RETURN	TOTAL CORE % 88.9%	SOLO CORE % 88.9%	R.O.D. % 88.9%	FRACT. INDEX PER Metre 0.25%	DIP BEDDING FL - Joint FO - Foliation CO - Convol. VN - Vein OR - Orthogonal CJ - Conjugate	FL - Planar CU - Curved UN - Undulating ST - Slumped IR - Irregular	PO - Polished K - Slickensides SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock	NOTE: For additional descriptions refer to list of abbreviations & synonyms.	WEATH- ERING INDEX	FEATURES	NOTES
		-- CONTINUED FROM PREVIOUS PAGE ...																
31		30.42 - 32.30 m · Slightly weathered, highly foliated, medium dark grey and dark red, fine to medium grained, non-porous, medium strong to strong, RHYOLITE CRYSTAL TUFF (RCTF) · Highly silicified, slight sericite/chlorite alteration · Trace disseminated very fine grained pyrite from 30.60 - 32.30 m																
32		32.30 - 41.24 m · Slightly weathered, weakly foliated, light grey with dark green grains, fine to coarse grained, non-porous, medium strong to strong, RHYOLITE CRYSTAL TUFF (RCTF) · Moderately silicified, slight sericite/chlorite alteration · Trace disseminated very fine grained pyrite		183.29 32.30		9												
33						10												
34						11												
35						12												
36						13												
37						14												
38						15												
39																		
40																		

CONTINUED NEXT PAGE

STARICK 030 19-1193-0003 GP J GAL-MISS.GDT 9/29/11 ET

DEPTH SCALE

1 : 50

Golder
Associates

LOGGED: ES

CHECKED:

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-04

SHEET 3 OF 3

LOCATION: N 5033577.3 E 434868.9

DRILLING DATE: AUG 16-17, 2011

DATUM:

INCLINATION: -90° AZIMUTH: --

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH/RETURN	JN - Joint FLT - Fissil SHR - Shear VN - Vene CJ - Convolute	BD - Bedding FO - Foliation CO - Contact CR - Orthogonal CL - Cleavage	PL - Planar CU - Curved UN - Undulating SF - Stepped IR - Irregular	PO - Polished K - Blk/Convoluted SL - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock	DISCONTINUITY DATA				WEATHERING INDEX	FEATURES	NOTES							
												RECOVERY 100% CORE %	BOND CORE %	R.O.D. %	SHACT INDEX P.S. Molar P.M.	DIP & L. CODES DIPS	TYPE AND SURFACE DESCRIPTION	NOMINAL CONDUCTIVITY K/cm/sec	10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴	10 ⁻⁵ 10 ⁻⁴ 10 ⁻³	10 ⁻⁴ 10 ⁻³ 10 ⁻²	W1 W2 W3 W4 W5 W6			
41		... CONTINUED FROM PREVIOUS PAGE ...															PO, PL, VR, SA, CH, SA	2	*						
41		END OF DRILLHOLE		174.35	16																				
42				41.24																					
43																									
44																									
45																									
46																									
47																									
48																									
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58																									
59																									
60																									

GTA-RCK-03D 10-1193-0003.G21 GALA.MSS.CDT 9/26/11 ET

DEPTH SCALE
1 : 50LOGGED: ES
CHECKED:

PROJECT: 10-1193-0003

RECDRD DF Drillhole: GB-05

SHEET 1 OF 4

LOCATION: N 5033620.4 ;E 434945.7

DRILLING DATE: AUG 19-20, 2011

DATUM:

INCLINATION: -80° AZIMUTH: —

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	FLUSH RETURNS	JN - Joint ELT - Molt SHR - Shear VN - Vein CJ - Conjugate			BD - Bedding LG - Foliation CO - Contact OR - Oblique CL - Cleavage			PL - Planar CU - Curved UN - Unfoliated ST - Stepped LR - Irregular			PO - Pointed K - Slickensides SM - Smooth RF - Rough MD - Faceted/irregular			BLZ - Broken Zone NOTE: For additional descriptions refer to page of observations & symbols			FEATURES	NOTES			
							RECOVERY INDEX TOTAL CORE % 23.9			R.O.D. PER MATERIAL 23.9			H.A.G. INDEX 23.9			DISCONTINUITY DATA			HYDROLOGIC CONDUCTIVITY K, cm/sec 10 ⁻³ 10 ⁻² 10 ⁻¹			WEATHERING DEPTH mm 10 ⁻³ 10 ⁻² 10 ⁻¹				
							PERCENT CORE % 23.9			%			DIP/WITH CORE AXIS 23.9			TYPE AND SURFACE DESCRIPTION			JL	W	N	W	N	W		
11.65	11.65	Continued from Record of Borehole GB-05	202.62	11.65	1																					
12	NQ-3 Bits / NQ Rods Taper Tidal Sampling	11.65 - 26.70 m Moderately weathered, foliated, dark grey to dark reddish brown, fine grained, non-porous, weak medium strong. RHYOLITE CRYSTAL TUFF (RCTF) - Strong silicification, slight sericitic/chlorite alteration, pervasive oxidation - Moderate water loss between 11.89 - 12.22 m (Broken/Lost core zone) - Numerous iron-rich veins between 11 - 40 mm thick																								
13																										
14																										
15																										
16																										
17																										
18																										
19																										
20																										
21																										
		18.40 - 18.55 m Very strongly silicified zone containing 3 cm diameter, globular pyrite																								
		CONTINUED NEXT PAGE																								

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-05

SHEET 2 OF 4

LOCATION: N 5033620.4 E 434945.7

DRILLING DATE: AUG 19-20, 2011

DATUM:

INCLINATION: -90° AZIMUTH: ...

DRILL RIG: D-120

DRILLING CONTRACTOR: Colman Engineering Co.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN NO.	FUSHER/RETURN	RECOVERY			DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY K, cm/sec			WATER- HOLDING INDEX			FEATURES	NOTES
							TOTAL CORE %	SOLID CORE %	R.Q.U. %	DIP/W.A. PER AXIS	CORE AXIS	TYPE AND SURFACE DESCRIPTION	J	N	15	10	7	12		
							48.83	20.62	88.9	0.82	0.82									
		-- CONTINUED FROM PREVIOUS PAGE --																		
22		11.65 - 26.70 m Moderately weathered, foliated, dark grey to dark reddish brown, fine grained, non-porous, weak to medium strong, RHYOLITE CRYSTAL TUFF (RCTF) · Strong silification, slight sericite/chlorite alteration, pervasive oxidation · Moderate water loss between 11.89 - 12.22 m (Broken/Lost core zone) · Numerous iron-rich veins between 1 - 40 mm thick			7							JN,PL,RO,CT,OXCH JN,PL,SM,CT,OX								
					8							JN,PL,RO,SA,OXCH								
					9							JN,PL,RO,SA,OXCH								
												FO,PL,VR,CT,M FO,PL,RO,ST,OX FO,PL,VR,ST,OX								
												FO,PL,RO,ST,DX								
												FO,PL,VR,IN,OX,1 mm								
26		24.89 - 26.70 m Dark green propylitic alteration zone			10							FO,PL,VR,IN,OX,1 mm FO,PL,VR,CT,OXCL FO,PL,VR,ST,DX FO,PL,VR,ST,OX								
					11							JN,PL,RO,CT,OXM								
					12							JN,PL,SM,CT,OXM								
					13							JN,PL,RO,CT,OXSA								
					14							SH,PL,K,ST,OX FR,PL,VR,CT,OXM FR,PL,VR,CT,OXM FR,PL,VR,CT,OXM FR,PL,VR,CT,OX IN,PL,RO,ST,OX IN,PL,RO,CT,OXCL,1 mm JN,PL,RO,CT,OXCL,1 mm								
												SH,PL,K,CT,OX SH,PL,RO,IN,OXCL,2 mm JN,PL,RO,IN,OXCL,2 mm JN,PL,RO,CT,OXCL,2 mm								
												JN,PL,RO,CT,OXCL								
												JN,PL,RO,IN,OXCL,1 mm JN,PL,RO,CT,OXCH IN,PL,VR,CT,OX								
												JN,PL,RC,CT,OXM JN,PL,SM,CT,OXCL								
												SH,PL,K,SA,CH SH,PL,K,SD,OXCH SH,PL,K,CT,011 SH,PL,K,CT,011 SH,PL,K,CT,011 JN,PL,SM,CT,OXCH IN,PL,RO,CT,OXCH								
29		29.70 - 41.76 m Slightly weathered, highly foliated, dark grey to dark reddish brown, fine grained, non-porous, weak to medium strong, RHYOLITE CRYSTAL TUFF (RCTF) · Strong to moderate silification, slight sericite/chlorite alteration, pervasive oxidation · More iron-rich veins to 38.00 m			15							CONTINUED NEXT PAGE								
					16															
					17															
					18															
					19															
					20															
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					27															
					28															
					29															
					30															
					31															

PROJECT: 10-1193-0003

RECORD OF Drillhole: GB-05

SHEET 3 OF 4

LOCATION: N 5033620.4 E 434945.7

DRILLING DATE: AUG 19-20, 2011

DATUM:

INCLINATION: -90°

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYNTHETIC LOG	ELEV. DEPTH (m)	BLK NO.	FLUSH RETURN	JN - Joint	BD - Bedding	PL - Plano	PG - Polished	BR - Broken Rock	NOTES
							FLT - Fault	FO - Foliation	CU - Curved	X - Slickensided	SM - Smooth	
VN - Vein	CO - Contact	UN - Undulating	SL - Smeared	SHR - Shattered	ST - Stopped	RD - Rough	MG - Mechanical Break					
CJ - Conjugate	CL - Cleavage											
RECOVERY %	TOTAL CORE %	SOLID CORE %	FRACT. INDEX	R.D.D. %	P.F.R. %	W.L. AREA	DISCONTINUITY DATA	HYDRAULIC CONDUCTIVITY	YIELDING INDEX	FEATURES		
9229	9229	9229	9229	9229	9229	9229	TYPE AND SURFACE DESCRIPTION	10 ⁻³ m ³ /sec	10 ⁻³ m ³ /sec			
		... CONTINUED FROM PREVIOUS PAGE ...										
32		29.70 - 41.76 m. Slightly weathered, highly foliated, dark grey to dark reddish brown, fine grained, non-porous, weak to medium strong, RHYOLITE CRYSTAL TUFF (RCT). - Strong to moderate silification, slight sericite/chlorite alteration, pervasive oxidation. - More iron-rich veins to 38.00 m.			14							
33					16							
34					18							
35					17							Bc
36					19							Dc
37												
38												
39												
40												
41					20							

DEPTH SCALE

130



LOGGED: 18

CHECKED:

PROJECT: 10-1183-0003

RECORD OF Drillhole: GB-05

SHEET 4 OF 4

LOCATION: N 6033620.4 ; E 434845.7

DRILLING DATE: AUG 19-20, 2011

DATUM:

INCLINATION: -90° AZIMUTH: --

DRILL RIG: D-120

DRILLING CONTRACTOR: Coleman Engineering Co.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. (m)	RUN No.	PUSH/RETURN	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	NOTES
							RECOVERY		R.Q.D.				
							TOTAL CORE %	SOLID CORE %	%				
42		-- CONTINUED FROM PREVIOUS PAGE --		42.51	20								
43		END OF DRILLHOLE		41.76									
44													
45													
46													
47													
48													
49													
50													
51													

GTA-RCK 030 10-1183-0003.GPR GALMISS.GDT 9/29/11 ET

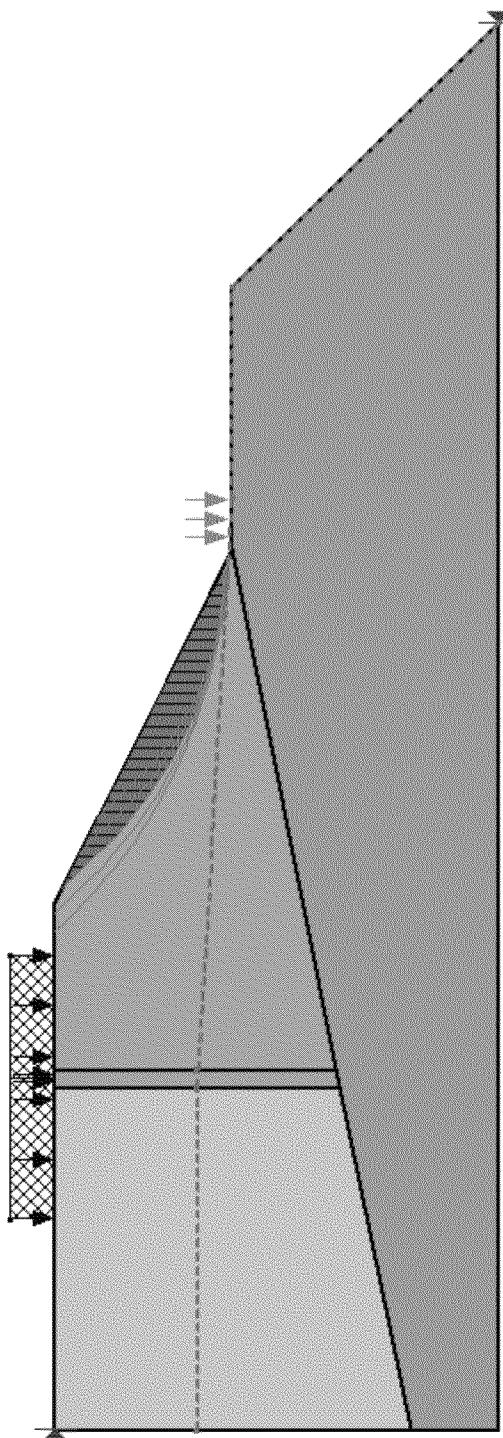
DEPTH SCALE
1:50LOGGED: ES
CHECKED:

Attachment 2

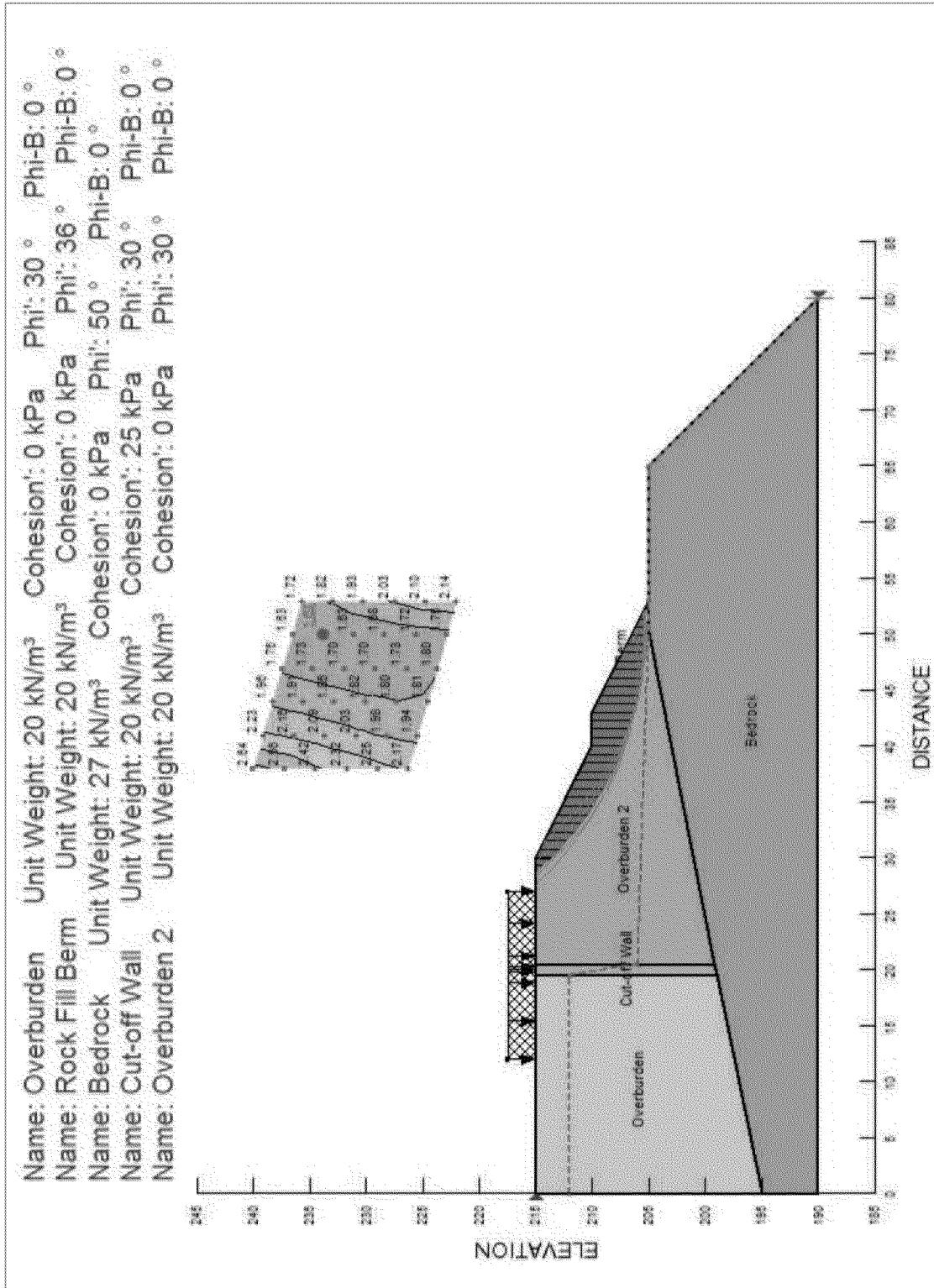
Slope Stability Analysis Results

Name: Overburden Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Phi-B: 0 °
 Name: Bedrock Unit Weight: 27 kN/m³ Cohesion: 0 kPa Phi: 50 ° Phi-B: 0 °
 Name: Cut-off Wall Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Phi-B: 0 °
 Name: Overburden 2 Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Phi-B: 0 °

	2.69	2.15	1.79	1.52	1.34	1.34
*	2.60	2.07	1.71	1.46	1.30	1.34
*	2.51	1.99	1.64	1.41	1.28	1.42
*	2.41	1.91	1.58	1.37	1.27	1.53
*	2.32	1.83	1.51	1.34	1.27	1.70
*	2.23	1.75	1.47	1.33	1.28	1.96
*	2.15	1.75	1.47	1.34	1.28	2.36
*	2.07	1.75	1.47	1.34	1.28	2.36
*	2.07	1.75	1.47	1.34	1.28	2.36

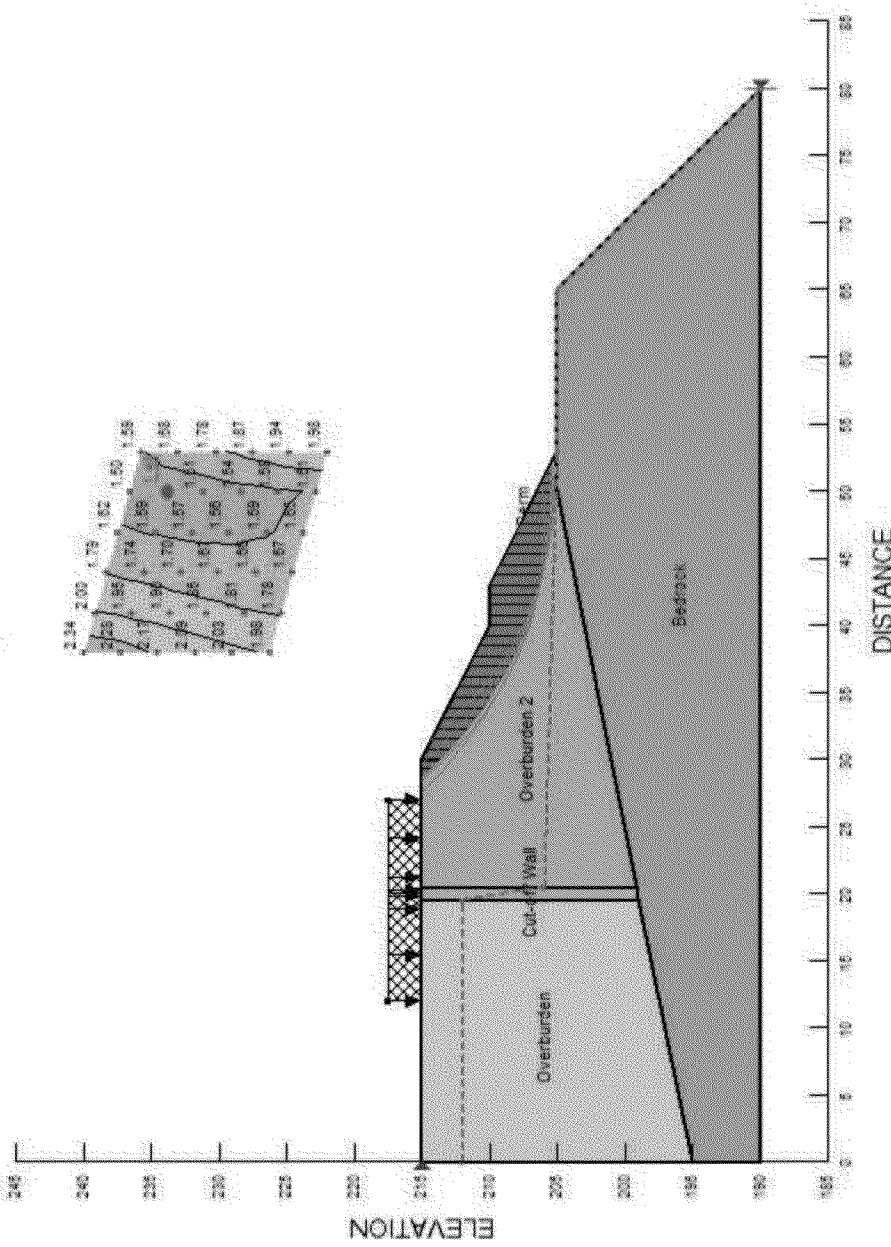
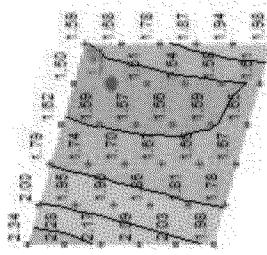


Slope Stability Analysis Result - Static Short Term Condition during Construction



Slope Stability Analysis Result - Static Steady State with a 100-year, 24-hour storm event

Name: Overburden Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Phi-B: 0 °
 Name: Rock Fill Berm Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 36 ° Phi-B: 0 °
 Name: Bedrock Unit Weight: 27 kN/m³ Cohesion: 0 kPa Phi: 50 ° Phi-B: 0 °
 Name: Cut-off Wall Unit Weight: 20 kN/m³ Cohesion: 25 kPa Phi: 30 ° Phi-B: 0 °
 Name: Overburden 2 Unit Weight: 20 kN/m³ Cohesion: 0 kPa Phi: 30 ° Phi-B: 0 °



Slope Stability Analysis Result - Pseudo-Static Long Term Condition with PGA = 0.03 g.